

Control of Childhood Lead Poisoning

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THE CONTROL of lead poisoning in children is a subject of increasing interest among physicians, the industries using lead in their products, public health workers, and informed citizens. This interest has grown rapidly in the past several years as a better understanding of the magnitude and the seriousness of the problem has developed.

Persons and agencies in several cities have initiated efforts to control the illness. None of these efforts is complete and the problem continues to be serious in even the cities with the most advanced programs.

Nature of Lead Poisoning

Childhood lead poisoning occurs primarily among children aged 1 to 4 years. Severe cases may result in death or mental retardation. This condition results from the accumulation of excessive amounts of lead in the body. Accumulation usually occurs from chronic exposure but may occasionally be produced by acute exposure as in the case of ingestion of a solid lead object (1-7).

Symptoms of the condition may be absent, are often vague, and may be easily confused with those of a number of other illnesses. Early diagnosis and treatment are necessary to cure or minimize the effects of the illness. Laboratory and other diagnostic tests are difficult, time-consuming, expensive, and in many communities they are not available. Lack of accurate diagnosis and reporting of all cases hampers prevention and control of the illness. Reporting is also a basic step in the develop-

ment of a program of prevention by making possible the investigation of cases and the determination of causes (5, 8-12).

Increased interest and more intensive investigation into childhood lead poisoning has led to the practice of obtaining blood lead levels in children who exhibit pica but are asymptomatic. Blood lead levels are also obtained in asymptomatic siblings of children with lead poisoning. As a result of this practice, the definition of lead poisoning is apparently changing. The diagnosis is being made with increasing frequency on the basis of elevated levels of lead in the blood without any symptomatic manifestations of poisoning. It is important to keep this fact in mind when attempting to evaluate the incidence of reported cases of lead poisoning in recent years and particularly in the future. The precise extent and effect of the changes in practices is not known at the present time.

Sources of Lead

Lead is present in various locations in the environment. The most common source of poisonings of children is the interior paint of older homes (1, 5, 13). Interior paints used before 1940 usually contained lead in an amount substantially greater than the level of 1 percent by weight, which is regarded as the safe limit (14). The interior of homes in older neighborhoods may contain many layers of leaded paint. Paint containing lead may also be found in exterior appurtenances of homes. Except for porches, the hazard to children in these locations is usually less serious, however, because a small child seldom has access to them for prolonged periods of time.

The results of systematic investigation of all reported cases by the Philadelphia Department of Public Health over a period of more than 7 years indicate that only about 65 percent can definitely be attributed to paint as a source of

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lead (1). Children's toys and children's furniture have been occasionally reported as a source, but the validity of these reports is doubtful except in the case of lead alloy metal toys. In only one case in Philadelphia was a toy determined to be the source. Other authorities have reported similar experience with toys (10, 15, 16).

There is a wide variety of other known and suspected sources from which a child may obtain lead. An attempt to list these in order of likelihood of involvement has been made by the Philadelphia Department of Public Health in its checklist of possible sources of lead which is used in field investigations (17).

Extent of Lead Poisoning

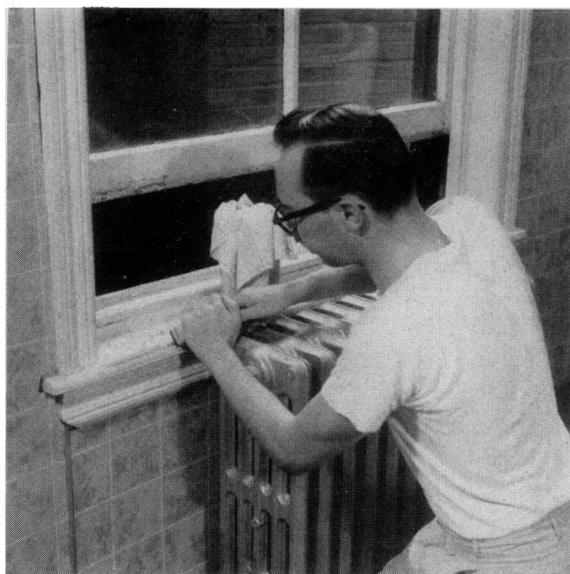
The true extent of lead poisoning in children is not known. Data as to its occurrence are fragmentary and limited to a few large cities. It is readily apparent that there are many other cities with directly comparable environmental and population characteristics. Even in cities in which action has been taken, data are believed to be misleadingly low in most instances because many cases probably remain undetected or unreported.

In Philadelphia, where efforts have been made to facilitate and stimulate reporting, 244 cases, with 12 deaths, were reported in 1962 (13). In the first 9 months of 1963, 111 cases had been reported with 4 deaths.

In Chicago, 178 cases with 16 deaths were reported in 1961 and 154 cases with 22 deaths reported in 1962. As of mid-September of 1963, 188 cases with 16 deaths had been reported (personal communication from Dr. Edward Press, chairman, Program Area Committee on Accident Prevention, American Public Health Association, September 19, 1963).

In Baltimore, 66 cases were reported in 1959. A total of 853 cases were reported from 1931 through 1960 (18).

In 1957, the latest year for which data are available, 76 cases of lead poisoning were reported to the St. Louis Health Department (personal communication from C. M. Copley, Jr., deputy health commissioner, St. Louis Department of Health and Hospitals, October 9, 1961). In 1960, the New York City Health De-



Father of a victim removing leaded paint from chewed surface

partment received reports of 140 cases (personal communication from Jerome Trichter, assistant commissioner, New York City Health Department, October 20, 1961). In 1959, 76 cases were reported in Cincinnati (personal communication from Dr. Lillis F. Altshuller, Lead Information Center, Cincinnati, October 5, 1961).

Even on the basis of fragmentary data found in several major cities, it is apparent that lead poisoning is of sufficient extent and consequences to warrant concerted attention.

Underlying Factors

Children up to about 3 years of age usually mouth and chew various objects. However, when a child develops an uncontrollable habit of chewing or eating inedible substances, this condition is known as pica. The cause of pica and its relationship to lead poisoning are somewhat controversial. Generally, however, pica is regarded as a major cause of lead poisoning since it enhances the likelihood of chewing painted surfaces or eating paint chips.

The concomitance of a complex of adverse social, economic, and environmental factors in areas of heavy incidence of childhood lead poisoning is well recognized. Also, there are numerous areas in which many generations of children have lived without reported or widely

recognized lead poisoning despite the presence of interior paint containing a harmful amount of lead. Variation in occurrence of recognized lead poisoning among children of the same family who have lived in the same environment during the same portion of their lives is also well known.

In some cases, investigation of the household showed adequate supervision of the children, a home adequately maintained and in good repair, and no discernible source of lead.

Clearly, there are many unanswered questions regarding both the environmental factors and the human factors in lead poisoning (19, 20).

Prevention

Prevention involves a series of interrelated activities which include the detection and management of cases with excessive absorption of lead but without symptomatic lead poisoning.

Detection. Detection requires screening studies of lead absorption in the bodies of children in the general population, routine reporting of diagnosed cases, and alertness to characteristics of children which may be conducive to the development of the illness. Such detection should be at the earliest possible stage so that specific measures may be instituted to prevent the development of incipient illness.

Routine reporting of all diagnosed cases to the health department is a basic requirement in evaluating and controlling the illness. This can be accomplished by mandatory legislation, but inducement in the form of services could encourage cooperation from physicians and hospitals. Service can be provided through distribution of results of epidemiologic investigations, free laboratory services for diagnosis, technical bulletins, consultation, and special investigations.

One of the most direct ways of discovering children with excessive lead absorption is through established screening routines in various medical settings. Well-child conferences and hospital outpatient departments offer particularly advantageous situations. Others include health department or voluntary agency clinics, hospital admissions, and visits to offices of private physicians.

The nature of the screening may vary according to the extent of interest which can be de-

veloped and according to the evidence of hazard or incidence of cases in each area. Appropriate laboratory tests should be employed in areas of substantial hazard. As a minimum, screening should include careful observation of possible symptoms and questioning of the parent regarding habits and symptoms which may not be apparent. Siblings and other children in the household should also be considered. Minimum screening efforts could be incorporated into home visits by private physicians and public health nurses in areas of appreciable incidence.

Household surveys of the general population would identify areas of existing or incipient serious lead absorption or poisoning.

Epidemiologic and environmental investigations. Thorough investigation of each reported case of lead poisoning in the home and at the hospital may reveal information which will assist in providing an insight into the causes and methods of prevention. Data may also be useful in treating a particular case and in making arrangements for a suitable environment for the patient after discharge from the hospital. In Philadelphia a special form is used for investigations.

Sample household surveys of at least the areas of high and moderate incidence will be needed to determine the nature and extent of sources of lead in the environment. Since paint is recognized as the most common source of lead in reported cases of poisoning, the survey should examine the level of lead in paint at several selected locations in each dwelling in the survey area. A simple chemical analysis using a procedure such as that developed in Baltimore would permit the large number of samples to be examined by a small staff (21).

So that all major sources may be considered, the survey must include at least the other major elements of the environment which are suspected as sources of lead. These include air, water, and soil. Although the role of toys is doubtful, attention to toys made of soft lead alloy would be desirable.

Education and counseling. The three major phases of education and counseling which need to be developed are professional education, public education, and selective education and counseling.

Education of various professional groups including physicians, nurses, hospital staffs, pharmacists, chemists, safety engineers, and others involved in the creation or treatment of the hazard or the illness, should be conducted vigorously because of their various basic contributions to the control program. Representatives of organizations of related businesses, such as paint dealers, real estate management or sales, property owners' associations, and others can also be of substantial assistance and should be kept informed of needs and developments. Members of these groups can help the control program in a variety of ways, including education of the general public.

Public education is required for various purposes with various groups. Important among these is its use to assist the leaders of the community to understand the seriousness of the illness in the hope that they will be willing to request official control resources and support necessary control measures.

Education of the public can be useful by alerting parents, relatives, and guardians of small children in risk areas regarding the existence of the hazard, how to recognize it, and the steps to be taken if suspicion is aroused. Primary focus should be on recent in-migrant minority groups who are underprivileged and have children under 5 years of age. These groups have the highest rates and are least informed.

It will be necessary to vary methods, materials, and media according to the habits and characteristics of the various groups. Groups having the highest incidence of lead poisoning are the most difficult to reach by the ordinary means of communication. The mass media have value for certain segments of the population, including the indigenous leaders of even the least-privileged groups. These media may include local and foreign-language press and radio programs as well as the metropolitan media.

Although community organization will be challenging and will require considerable time and effort, it can be particularly useful in reaching the public. Community organizations may provide one of the few avenues for reaching the underprivileged. In addition, such families are usually more likely to accept a message

from an organization to which they belong or an individual whom they know and trust.

The most productive method of transferring information is on an individual basis. In the case of childhood lead poisoning, direct counseling of parents by persons whose competence and position they respect is possible in a variety of situations, such as the private physician's office, the hospital clinic, or the health center, or during visits by representatives of these organizations. A few brief questions, a few words of caution, and some handout educational materials can be incorporated into almost any such situation.

Legal controls. Legislation is needed to permit the control of lead as it is found in various sources and in various situations. Specific regulations which may be promulgated under a broader ordinance power include prohibition of the application of paint containing more than 1 percent lead on parts of dwellings accessible to young children, compulsory removal of existing hazardous paint, precautionary labeling of fresh paint to warn of the hazard from lead content, and prohibition of the application of fresh paint with more than 1 percent lead on interior locations of dwellings accessible to young children. Although differences of opinion exist regarding toys, many persons competent in the subject feel that legal standards should also apply to paint and metals of toys.

Services. Two kinds of laboratory services could be provided to the community without charge. The first of these is the analysis of blood and urine samples for lead content, because of the basic value of these tests in detection and diagnosis of the illness. Other screening tests are basic detection tools and could be regarded as an extension of this service. Either the screening tests or the diagnostic tests would be available for use at any point of suspicion or action and at the discretion of the physician or hospital. They will also be useful in surveys and research activities. Laboratory services could also include chemical analysis of paint or other suspected sources of lead in the environment.

The social services required to deal with the numerous and varied family problems encountered in treating or preventing lead poison-

ing in children can be provided through a qualified social worker. To provide maximum integration of this function, it would be desirable for the social worker to be on the staff of the program agency if the workload requires a full-time person. Contractual services from an appropriate agency might be preferable to use of a part-time employee.

Minimization of the Illness

Efforts to minimize the illness and its effects when a case has not been prevented are properly a part of the community program even though most such activities are responsibilities of hospitals, private physicians, and voluntary agencies. They should proceed through treatment to a continuing effort for rehabilitation so long as further reduction in the effects of the illness appears possible.

Screening may be regarded as part of the effort to minimize consequences in that it leads to early diagnosis. As such, it is an important part of the contribution which can be made by physicians and hospitals.

Early and rapid diagnosis is an important factor in the successful care and minimization of effects of lead poisoning. Availability of the services mentioned earlier and sharing of results of epidemiologic and environmental investigations with the hospital staffs is important in facilitating decisions related to diagnosis.

Continuing emphasis on the existence of lead poisoning and community efforts aimed at professional education on its nature and hazards are basic needs to assure adequate diagnosis and treatment. This aspect of the community program is especially important in view of the many uncertainties and differences in viewpoint among physicians in regard to the diagnosis and handling of asymptomatic cases.

The physician or hospital should remain in close contact with the health department after reporting a case in order to be assured that all possible efforts are being made to remove the known sources of lead from the environment before the child is returned to his home.

Attention to the child who has had lead poisoning should not be discontinued when he is released from treatment. Since the continuation or usefulness of a life is often involved,

rehabilitation efforts should be initiated and continued to the maximum useful extent which technical and community resources will permit.

Research

The need for research into a variety of aspects of the condition and its control is well recognized. The nature of the needed research is varied. It includes epidemiology to attempt to determine not only the overt but the underlying causes of ingestion and to discover the sources of the lead. Although the physical environment is the source of the lead, the complexities of the social, economic, and cultural environment must also be considered. The mode of translation of these factors into elements which may cause or predispose to the illness is not known.

Medical research, both physical and psychiatric, is also needed to explore such questions as the reasons for pica, the reason for the apparent coincidence of respiratory diseases and lead poisoning, the effects of nutrition on pica and on lead absorption, why some siblings develop the condition and some do not, the relationship of anemia and pica, the development of rapid and reliable screening tests, the possible use of oral medication instead of injections, and a variety of other factors which may influence the development or control of the condition.

Three directions of research are needed in preparing to control the environment: (a) means of removing or neutralizing the known existing sources of lead, such as paint, in the environment; (b) discovery of unknown sources and the quantitative measurement of their effect; and (c) measures to be used to substitute or otherwise prevent the introduction of lead into the environment in a hazardous manner in the future.

Philadelphia's Program

Reporting of lead poisoning to the Philadelphia Department of Public Health was made mandatory in 1950. For several years, a limited number of cases were reported, possibly because of lack of awareness of the disease with consequent failure to recognize it, some absence of realization that reporting was required by law,

and an appreciable feeling that reporting served no purpose because no constructive action resulted.

Interest in the control of nonoccupational lead poisoning was first manifested by the accident control section of the Department of Public Health in 1953. Since that time, responsibility for the control of childhood lead poisoning has been a part of the section's overall accident control program. Followup investigation of each reported case was initiated in 1956 when 33 cases were reported. There were 50 cases reported in 1959 and 56 cases reported in 1960 (1).

To increase awareness and understanding of the disease as well as to stimulate reporting, copies of reports of all investigated cases are sent routinely to the reporting physician and the hospital where the child is receiving treatment. Copies of statistical reports are also sent to the hospitals and selected medical groups as prepared. Literature and other information of professional interest is distributed. A major method of such distribution is through the poison control coordinators in each hospital. The coordinator is a staff member, usually professional, who has been appointed by the hospital to serve as liaison with the health department on all poison control activities, to oversee reporting, and to serve as a focal point of information on the control of accidental poisoning, including lead poisoning. Control of accidental poisoning by substances other than lead is conducted by the department as a program separate from activities in the control of lead poisoning. This is because of large differences in etiology and control measures.

A citizens committee was formed to advise the department in policy formulation, program planning, and development of major procedures. Membership includes a variety of interests, ranging from a representative of the Philadelphia Board of Realtors to a pediatrician who is concerned primarily with the rehabilitation of effects of the illness. Several subcommittees of specialty areas have been formed. The value of this committee has been chiefly in clarifying and enlisting support of community policies and programs on this subject. In addition, the members have provided extensive assistance, both technical and operational, on an individual basis.

A symposium on the control of childhood lead poisoning was held in the spring of 1961 for professional, business, and community groups. Medical, environmental, and social considerations were discussed. This symposium constituted a major milestone in the advancement of community acceptance of the seriousness of the poisoning and the development of community support of current and proposed control efforts.

Quantitative analyses of blood and urine samples for presence of lead are provided to the physicians and hospitals of the community without charge. This free service makes these tests available to all residents of the city without regard to means. Since most of the persons affected are from the lower income groups, the absence of cost is particularly important. The service also provides a stimulus to reporting. A major value of the service is that it provides uniform, centralized testing techniques and criteria, thus making possible comparability among the various reporting hospitals. The laboratory work of the service is performed on an interim basis as a contribution to the health department program by the Electric Storage Battery Company of Philadelphia. Hopefully, in the future it will be possible to conduct these tests in a health department laboratory. Such an official laboratory would further improve the service by focusing attention primarily on the conduct and interpretation of the tests as they relate to young children.

As the service is currently performed, the health department provides the kits for collection, receives and transmits the samples, and distributes reports of results of the analyses to the reporting physician or hospital. In connection with this service, each physician is requested to complete a checksheet designed to determine the presence and nature of pica or other symptoms. Approval for a home visit is also obtained through this form.

The followup investigation of each reported case is conducted by the staff epidemiologist of the division of environmental health. This investigation produces clinical, social, and environmental data.

A checklist of potential sources of lead is also used in these investigations (17). This list is composed of all potential sources of lead known to the department, listed in decreasing order of

likelihood of incrimination. Samples of suspected sources of lead are obtained, and quantitative analysis for lead content is conducted in the laboratory of the division of environmental health.

Copies of the report of the followup investigation are sent to the district health director and the supervisor of public health nursing of the district in which the victim resides, the communicable disease section of the health department, the reporting physician, the poison control coordinator of the hospital where the child was treated, and, in fatal cases, the office of the medical examiner. Such wide distribution of reports of each case has been quite valuable in developing interest and cooperative relationships.

The cooperation of landlords is sought in the voluntary removal of leaded paint when it is found to be the source. In about 20 percent of the cases, landlords have assisted in the removal. In other instances, however, cooperation was limited to permission for the tenant to remove the leaded paint and to repaint with a safe product. Many of the tenants are not able to do this work because of economic or other reasons. In such cases, the Social Order Committee of the Religious Society of Friends has assisted the family in the necessary correction and repainting. Screening of need and referral to the Social Order Committee is done by the health department. Members of the Lead Poisoning Advisory Committee have contributed the paint remover and fresh paint in these cases.

After she is notified that the epidemiologic investigation has been made, a public health nurse makes a followup visit and counsels the family on the prevention of lead poisoning, refers other siblings for attention if necessary, and also discusses other general health needs. Copies of the findings of the nurse's followup visit are sent to the reporting physician.

When a hospital has made a reasonable but unsuccessful effort to have a patient return for additional treatment, a referral by the hospital may be made to the appropriate health district for public health nursing service. The public health nurse then visits the family, attempts to determine why the patient did not return to the hospital, and seeks to help the family overcome

the obstacles. The information obtained is then given to the referring hospital so that the concerned group within the hospital can learn more about the case and thereby work out a plan to assist the family in continuing to receive necessary attention.

Education of the public has been partially accomplished through the usual educational techniques, including preparation of articles and distribution of an educational leaflet (22). Periodically, information has been disseminated through the press, radio and television, and talks to community groups. In at least three instances, mothers who had read the leaflet recognized symptoms suggesting lead poisoning in their children. These children were taken to a physician and subsequently diagnosed as having lead poisoning.

A preliminary survey of 100 homes of Puerto Ricans living in a high-incidence area was conducted in 1958. The purpose of this survey was twofold. One was to test the survey procedures in anticipation of possible large-scale use to study all of the areas of high or moderate incidence. The other was to begin to develop some insight into the extent of leaded paints in the older poor-quality areas. In 87 percent of the dwellings surveyed, at least one location accessible to children was found to have a hazardous concentration of lead in the paint (23).

In addition to efforts to correct the environment of reported cases, investigations are also conducted on request of the physician in suspected cases of lead poisoning. Such requests are usually made when a high blood lead level is found, but the patient is asymptomatic. The investigatory procedure and landlord followup are the same as for reported cases. These investigations are not only valuable in preventing further development of the condition, but they provide a much-appreciated service to the treating physicians and hospitals.

A major limitation of the program at this time is the lack of legal powers to enforce removal of environmental hazards when they are discovered. Proposals have been prepared for legislation to control all recognized sources of lead. These proposals are currently being reviewed. It is hoped that legislation will be enacted in a form which will make possible the removal of environmental hazards on a pre-

ventive as well as a corrective basis. Although the individuals and organizations of the Lead Poisoning Advisory Committee represent a variety of different and sometimes conflicting viewpoints, they have been of great value in the preparation of the legislative proposals.

Summary

A review of the nature, sources, and extent of lead poisoning indicates that it is a cause for major concern as a health hazard to children under 5 years of age. Concern should not be limited to the urban areas now giving attention to the illness.

Lead is present in various parts of the environment. The major but not exclusive source is paint in older homes. Presence of lead is not the only factor in development of poisoning. There are also underlying factors which are not clearly understood.

Recommended prevention measures include screening of subclinical cases, early and rapid diagnosis, routine reporting, epidemiologic investigation, environmental appraisals, education and counseling, enforcement of legal standards, and adequate laboratory and social services.

Minimization of the disease and its sequelae is as important as prevention. Therefore, it requires as concerted attention as prevention.

Research is needed into overt and underlying causes; social, economic, and cultural factors; medical aspects of the condition and its causation, both physical and psychiatric; and measures to control environmental hazards.

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